SHELL SAND CORE MACHINE

BACKGROUND OF THE INVENTION

FIELD OF THE INVENTION

The invention relates to automated core molding systems and, more particularly, to a method and apparatus for the blowing and curing of cores wherein the special core box (matrix) remains in a fixed vertical plane during core formation and curing.

DESCRIPTION OF RELATED ART

Metal castings are typically produced by the introduction of molten metal into a mold in the form of the casting, also termed a "core," typically utilizing sand as the core material. As an initial step in the process, the core must be formed and cured. This occurs in a core box (matrix). The forming of the core is termed "blowing," and involves the introduction of resin coated sand into a core box (matrix) to produce a core in the desired casting shape. A problem with the prior art is the difficulty in retaining the proper shape of the uncured core during the movement of the core box (matrix) prior to curing. This results in cores of variable quality, and consequently results in castings of unacceptably variable quality.

The removal of the cured core from the core box (matrix) can be very difficult when the draft angle of the core box cavity is very small. Should a portion of the cured core break off of the larger removed core and is retained in the core box it will be very troublesome. The cured core is hard and could be difficult to remove. The use of any sharp tools or excessive force can mar or damage the core box (matrix) which will acerbate the condition and subsequently made cores might not be drawn (removed) easily.

Accordingly, special emphasis is needed in the machine design to allow for a very controlled drawing of the core. Provisions also are needed to assist in ejecting (removal) of the core from the core box (matrix).

Another problem with the prior art is that the sand fill station is not sufficiently isolated from the cure station. Curing of the cores involves the application of heat. The curing process ensures that the sand core retains the proper shape of the casting, and more particularly, retains the proper shape to the required dimensional tolerances. The resin coated core sand that is used in producing the shell cores is very special and expensive. In the typical prior art arrangement, sand is introduced into the core box (matrix) from a reservoir, or fill station proximal to the cure station. Consequently, heat from the cure station may initiate the curing process in the sand while it is stored in the fill station prior to blowing into the core box, whereby the sand in the fill station becomes partially or fully hardened before it is introduced into the core box and is unable to produce a core in the desired consistency and casting shape.

Another problem with a hollow core, the sand in the inside is not totally cured and the grains of sand have little or no strength and are not bonded together. This can result in quality problems during subsequent manufacturing operations.

Operation of the prior art is typically accomplished by the use of pressurized air to deliver sand to the core box (matrix), as well as for cylinder and valve operation. A problem with the prior art is that, if a single source of air is utilized to provide both "control air" and "blow air," erratic machine movement can result from the decompression of the control air during the blowing process, which results in cores of variable quality.

SUMMARY OF THE INVENTION

These and other problems of the prior art are overcome in accordance with this invention by a core molding system that incorporates a separate sand fill station, a separate clamp,

blow and cure station, and a separate cope eject and unload station. Specially designed equipment is used to remove unneeded core sand from the core cavity. In addition, external heat is applied to the hollowed out core to aid in curing the core. In accordance with one aspect of the invention, the core box (matrix) remains in a fixed vertical plane during the core formation and the clamping, blowing and curing stages. In accordance with another aspect of the invention, a special tooling mount on the clamp table, or pattern pins, move up and down in a vertical plane and eliminate the possibility of sand shift prior to curing of the sand with heat.

In one particular embodiment of the invention, the sand fill station, is adapted to keep the heat-curable sand away from the blow, and cure stations. A sand supply hopper gate discharges sand into a fabricated sand magazine which is attached to a transfer car. The transfer car moves the sand magazine horizontally in and out of the separate clamp, blow, cure station stages, as required.

Advantageously, after the sand filled core has been blown in a shell-type or solid mold, and prior to being totally cured, a specially-designed sand removal device or vacuum manifold is introduced into the core box to remove any excess resin-coated sand, and to reclaim from the inside of the core any resin-coated sand that is not required before the sand in the core or mold is cured. Advantageously, this improves the quality and precision of the molds.

After the core has been cured, utilizing a heating element or burner, the resulting core is stripped from the drag and remains in the cope section of the core box tooling. The cope section is shuttled out away from the vacuum manifold and heating manifold on transfer arms that are attached to another transfer car, and into an eject and unload station. The transfer arms also have the ability to move up and down as well as adjusting the levelness of the core box. A special pattern blow-off and spraying of pattern release agents is incorporated into the machine.

Furthermore, in one particular embodiment of the invention, the clamp, blow, and cure station is supplied with separate control air and blow air sources, including a reservoir of pressurized blow air, which avoids the compression of control air during the blow cycle and eliminates the resultant erratic machine movement during peak air demand. Also, the control air needs to be lubricated to allow for valves and cylinders to function more reliably; however, oil in the blow air would be a detriment to the core making process.

In accordance with another aspect of the invention, the core molding system is in a particular position and operation of the fill station and cure station, such that the reservoir of sand in the fill station is positioned with respect to the cure station to minimize premature curing of the sand prior to its introduction into the core box and the initiation of the curing process.

Another advantage of the core molding system in accordance with this invention is the use of a fixed core box for the forming and curing process. The single station utilized for both forming and curing the core eliminates movement of the core box after formation and before curing which frequently causes settling and shifting of the sand prior to curing in the prior art.

BRIEF DESCRIPTION OF DRAWINGS

The invention will now be described with reference to the drawings wherein:

FIG. 1 is a frontal view of a core molding machine **10**, incorporating principles of the invention;

FIG. 2 is a front elevation view of the machine frame assembly **12** for the core molding machine of **FIG 1**;

FIG. 3 is a right hand end elevation view of the core molding machine of **FIG 1**;

FIG. 4 is a the left hand end elevation view of the machine frame assembly **12** for the core molding machine of **FIG 1**;

FIG. 5A is the left hand end view of the core molding machine of **FIG 1**;

FIG. 5B is a front elevation view of the core unloader table portion of the machine frame assembly **12**;

FIG. 6A-D are multiple views of the unloader car assembly **43;**

FIG. 7A is a right-hand elevation view of the vacuum manifold **27,** upper burner manifold **31,** attached to the machine frame assembly **12**; and

FIG. 7B is a plan view of the vacuum manifold **27** and the upper burner manifold **31.**

DETAILED DESCRIPTION

Depicted in **FIG. 1** is a frontal view of the core molding machine **10** incorporating a heavy machine frame assembly **12 (FIG. 2)** which supports a sand hopper **14**, an air reservoir **16**, and a blow head **17**. A clamp table **22** and pattern pins **24** support a core box (matrix) **26** which consists of a cope **28** resting on a trunnion system **20** that is compressed against the drag **32** to form a core **34**. The core box (matrix) **26** is brought adjacent to a sand chamber transfer car **36.**

As shown in **FIG. 1,** the blow head/sand magazine **17** and sand chamber transfer car **36** are aligned with the sand hopper **14** in a position to receive the sand. Sand is introduced from the sand hopper **14** to the blow head/sand magazine **17** through the operation of the sand hopper cylinder **47** which opens and closes a valve in the sand hopper **14** which releases the sand by gravity when the sand hopper cylinder **47** is extended. The sand hopper **14** is closed by retraction of the sand hopper cylinder **47** after the sand has been introduced into the blow head/sand magazine **17**.

The sand chamber transfer car **36** with the blow head/sand magazine **17** filled with sand is then moved laterally on Osborn v-wheels **38** that move across an upper horizontal track **40** through the action of the sand chamber transfer car cylinder **50** towards the core box (matrix) **26** until the blow head/sand magazine **17** is aligned with the center line of the core box (matrix) **26**, the clamp table **22**, and the blow chamber **18**. The clamp table **22** is raised to elevate the core box (matrix) **26** to a position immediately below the blow head/sand magazine **17** by means of an

extended clamp cylinder **46**. After the clamp table **22** is raised to place the core box (matrix) **26** in a position immediately below the blow head/sand magazine **17**, the blow valve **52** is opened and pressurized air from the blow air reservoir **16** delivers air to the blow chamber **18** to the blow head/sand magazine **17** into the core box (matrix) **26**. After the correct volume of sand is delivered to the core box (matrix) **26**, the blow valve **52** is closed and excess air is released from the blow exhaust chamber **54**.

FIG. 2 schematically illustrates the machine frame assembly **12** supporting an upper horizontal track **40**, a lower horizontal track **41**, pattern pins **24**, a stripper plate **45**, and an unloader table **48**.

As depicted in **FIG. 3**, the clamp table **22** and the core box (matrix) **26** are lowered by the operation of the clamp cylinder **46** to the cure position. The blow head/sand magazine **17** is moved away from the core box (matrix) **26** during curing. The blow head/sand chamber transfer car **36 (FIG. 1)** returns by means of retraction of the blow head/sand chamber transfer car cylinder **50** to a position in alignment with the center line of the sand hopper **14**. As shown in **FIGS. 7A and 7B,** a vacuum manifold **27** is provided to a set depth inside the blow openings to remove excess resin coated sand from the top of the cope **28**. The vacuum manifold **27** extends by the operation of a vacuum cylinder **29** to the core box (matrix) **26** and removes excess resin coated sand from the core box (matrix) **26**. The sand is returned to the sand hopper **14** for the next core **34** forming cycle. The vacuum manifold **27** remains extended through the operation of the vacuum cylinder **29**.

The upper burner manifold **31** extends by operation of the burner cylinder **33** to the core box (matrix) **26** and heats the core box (matrix) **26** to cure the core **34**. Proper cure temperature is maintained by the use of thermocouples. Heat may be provided through the use of gas-powered or electric-powered heating elements, or, as is contemplated here, a combination of the two. After

curing is completed, the upper burner manifold **31** and vacuum manifold **27** are retracted by operation of the burner cylinder **33** and vacuum cylinder **29** together.

The clamp table **22** is lowered by means of the clamp cylinder **46**, placing the cope **28** and core box (matrix) assembly **26** on the unloader transfer arms **44** **(FIG. 6B)**. Vibrators mounted on the core box are activated and the clamp cylinder **46** lowers the drag **32** away from the cope **28** and core box (matrix) assembly **26**. The unloader transfer arms **44** move the cope **28** and core box (matrix) **26** assembly laterally by means of the core unloader cylinder **56** **(FIG. 5B)** to a position above the core unloader table **48**. The core unloader table **48** is raised by means of the core unloader cylinder **56** to a position beneath the core box (matrix) **26**. The core **34** is removed from the core box (matrix) **26** by pressing the core against stripper plate **45** **(FIG. 5A)** and controlled lift of core unloader cylinder **56** and placing the core on the core unloader table **48**. The core unloader table **48** is lowered by means of the core unloader cylinder **56** with the core **34** ejected from the core box (matrix) **26**. The unloader transfer arms **44** move the empty cope **28** laterally to the clamp table **22** by means of the core unloader cylinder **56**.

The core box (matrix) **26** is reassembled utilizing the cope **28** and drag **32** sections by elevating the clamp table **22** to bring the cope **28** adjacent the drag **32**.

The core molding machine **10** also incorporates an air supply unit providing air under pressure, a hydraulic unit providing hydraulic fluid under pressure, an electrical supply box, and an electronic controller that are standard components in the art. The electronic controller may be a programmed logic array designed to provide electrical signals to operate various air and/or hydraulic valves and/or relays. The electric box provides electrical power when required.

While particular embodiments of the invention have been shown, it will be understood that the invention is not limited thereto since modifications may be made by those skilled in the art, particularly in light of the foregoing teachings. Reasonable variation and modification are

possible within the scope of the foregoing disclosure of the invention without departing from the spirit of the invention.